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CROP EVERSION IN CHAOBORID LARVAE (DIPTERA)

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Abstract

On the available evidence it seems likely that the larva of *Chaoborus* normally, but perhaps optionally, voids the remains of its prey by everting the crop. For other chaoborid genera the evidence is less convincing, and crop eversion, as seen in specimens, may be only an artefact of preservation.

With one known exception, the larvae of Chaoboridae are aquatic predators (the exception is the filter-feeding *Australomochlonyx nitidus* Freeman; Colless 1977). However, the way that they consume their prey seems unique amongst insects. Mature chaoborid larvae prey mainly on small crustaceans (copepods, ostracods, and cladocerans); but larger creatures, such as mosquito larvae or other chaoborids, may sometimes be taken (Edwards 1932, Wesenberg-Lund 1943, Deonier 1943, James 1957, O'Connor 1959, Swift and Fedorenko 1975). The prey is swallowed whole into a long, distensible, muscular crop that terminates posteriorly at a sphincter that may bear spines or plates, forming a sieve. Strong contractions of the crop squeeze the prey and expressed body fluids are filtered at the sphincter while being pumped to the midgut. According to Montshadsky (1945) digestion, too, occurs in the crop, by enzymes pumped back from the midgut.

So much seems well established, as is, too, the fact that larvae are only occasionally seen with prey in the crop. It follows that the pellet of compressed remains is voided from time to time, and that it must be voided through the

mouth, since the pellet could not pass the sphincter; but the question remains precisely how is it ejected?

The question would be pretty trivial were it not for a striking an unusual feature of chaoborid larvae: preserved specimens often have the cro completely prolapsed through the mouth opening. Edwards (1932) describe this as a feature of all genera of Chaoboridae with the possible exception o *Corethrella*; and I can now report having observed it in a specimen of a undescribed Australian species in that genus. The fact that eversion of the cro tends to be uniformly present or absent in a given batch of specimens show that the phenomenon, as seen, is an artefact of preservation. No doubt it caused by a sudden increase in blood pressure through diffusion of fixativ or muscular contraction; Deonier (1943) reports eversion following ligh pressure with a needle. Nonetheless, if the crop is so easily everted, it migh perhaps occur naturally as a means of ejecting the remains of the prey. An that would add yet another distinctive feature to a most unusual kind of feedin behaviour.

Two authors have asserted that in *Chaoborus* eversion is in fact a norma feature of behaviour (Herms 1937, for *C. astictopus* Dyar and Shannon; an Montshadsky 1945, for *C. crystallinus* de Geer). Herms was retailing observa ions by a trusted field officer, R. W. Burgess, who had abundant opportunit to study live material; and Montshadsky leaves no doubt that he actuall observed prolapse of the crop. In addition James (1957) states that in *Mochlony velutinus* (Ruthe) remains of the prey are 'ejected by the eversible crop'; bu it is not clear whether he actually observed eversion to occur.

On the other hand Deonier (1943), also studying *C. astictopus*, found tha the crop was emptied simply by reverse peristalsis. He saw eversion 'only i injured specimens'. Likewise O'Connor (1959) observed only 'regurgitation' i *Mochlonyx cinctipes* (Coq.). I can add to these my own observation of a sing case of reverse peristalsis (and none of eversion) in larvae of an Australia species of *Chaoborus* ("Ingham species", undescribed). It is extremely difficu to catch a larva at the precise moment of clearing its crop; but if eversion wa regularly practised by larvae in the batch that I watched, then retraction mus have been very rapid.

The simplest interpretation of these conflicting reports would be tha *both* forms of behaviour occur. However, most folk would, I think, remai suspicious of the eversion story without additional supporting evidence. As i happens, this can be easily found in the case of *Chaoborus*. Measurements o two Australian species and on Figure 3a in Herms (1937) show that the cro constitutes about one quarter of the total length of the gut. If, then, a larva regularly and suddenly to protrude through its mouth such a substantial pa of its viscera, we might expect to find correlated adaptations that act t minimise traumatic side effects. And such a feature is plainly evident in th posterior segment of the oesophagus. This segment is about as long as the cro but much narrower, with a fine lumen and walls of compact muscle that includ conspicuous longitudinal members. It should therefore serve admirably as a

elastic device to absorb both shock and displacement if the crop were suddenly everted. Indeed, it is hard to imagine what other function it could serve.

I therefore find it quite credible that *Chaoborus* larvae have eversion of the crop as a normal, but optional feature of behaviour. The option might be exercised only when the fully compressed prey still distends the crop past some limiting volume, through capture of an unusually large creature or several smaller ones in quick succession. Such distension could be expected to increase the larva's blood pressure so as to assist, if not by itself to meditate, eversion of the crop.

On the other hand, there is little to suggest that such behaviour occurs normally in other chaoborid genera. My own observation of *Australomochlonyx*, *Promochlonyx*, *Mochlonyx* (*M. culiformis* de Geer), *Eucorethra* and *Corethrella* (2 unnamed species) show that all have the crop connected to the midgut by a short and unremarkable segment of oesophagus. It is therefore hard to believe that in these genera frequent and total eversion of the crop would not be damaging to the rest of the gut. It might, of course, occur occasionally as an unfortunate addicent, of a kind that the highly specialised *Chaoborus* has turned to its benefit.

A final question: how is the prolapsed crop retracted? According to Montshadsky (1945) it is "swallowed with the help of the mouthparts and the antennae". In fact, it is a fair conjecture that the protruding crop is perceived as prey and eaten in the normal fashion. So it may be no coincidence that, as also noted by Montshadsky, *Chaoborus* does little physical damage to its prey while swallowing it!

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